

Wool and Mohair

As wool in the 1950's lost ground to synthetic fibers, researchers at WRRRC identified several shortcomings that would have to be overcome if wool were to become more competitive. Wool garments shrank during machine laundering. Wool fibers wrinkled, particularly during travel. Trousers lost their crease. Large amounts of water and energy were required to clean raw wool, and it was yellowed by sunlight. There was also the need to make wool repel stains and retard flames and accept dyeing more readily. Finding solutions to this long list of difficult problems occupied Western wool researchers for 30 years.

After several years of basic research on the nature of wool fibers and many unsatisfactory experiments and trials, a team of Western scientists developed in 1960 a revolutionary method for shrinkproofing wool. In a two-part process, a microscopic film of nylon was bound permanently to the surface of wool fibers. The thin film changed the frictional characteristics of each fiber and allowed wool fabrics to be washed in machines and tumble-dried without shrinking. There was no significant change in the feel or texture of wool products. The technical name for the innovation was interfacial polymerization, but it became known popularly as the WURLAN process. Within a short time, it was adopted by large textile firms in the United States and Europe.

During the next 20 years, new shrinkproofing processes were developed and the original process improved. One new method, perfected in 1978, proved particularly useful for smaller textile operations. It consisted of a one-bath system that applied emulsified polyurethanes to the wool in conventional washing machines. One of the first companies to use the small-scale method manufactured and supplied prosthetic socks to veterans' hospitals.

In another shrinkproofing process, wool fibers were exposed to a low-temperature electric glow discharge, which not only made the woolen fabric shrink-resistant but also more receptive



Chemists William Marmer (foreground) and Paul Magidman analyze wool constituents at the Eastern center to determine effects of chemical and physical treatments.

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to certain dyes. Yet another technique made fabrics simultaneously shrinkproof and stain-repellent.

Credit—or blame—for popularizing sharp creases in men's trousers is said to belong to Edward VII of England, who started the fashion in the second half of the 19th Century during his long tenure as Prince of Wales. But Edward had a valet whose job it was to press his trousers. It was not until the early 1960's that a WRRRC team found an acceptable way to provide ordinary citizens with wool trousers that had built-in creases that could survive even rainy weather.

A WRRRC scientist described the process very well. "The creasing of wool fabrics," he wrote in 1962, "involves the same general principle as the permanent waving of hair. Fibers are exposed to a chemical solution that penetrates their internal structure and unzips chemical linkages that tie together the web of threadlike molecules. The separated molecules can now slip past one another when the assembly of the fiber is strained, as during the pressing of a garment. New chemical crosslinks are formed almost immediately between the molecules in their new positions." The process was quickly adopted by the U.S. military to put permanent creases in uniform trousers.



ERRC chemist Christopher Carr monitors bleaching reactions on samples of urine-stained wool.



After conducting flame tests on wool, Mendel Friedman, WRRC research chemist, compares fabric on left treated with chemical flame retardant with untreated fabric on right. The treated fabric charred slightly but wouldn't ignite.

Mohair, the hair of Angora goats, underwent laboratory modification in 1969 under the influence of a strange piece of apparatus. A textile chemist studied what happened when he passed mohair fibers through the atmosphere between two electrically charged plates. The electrical device, called a corona reactor, was built at the Western lab to modify fibers from sheep and goats chemically. What the reactor did to mohair was to remove the fiber's slickness, a property fortunately lacking in wool. The slickness of untreated mohair fibers makes them difficult to handle during carding, spinning, and other steps in converting raw fiber into finished textiles. In ways not entirely understood, passage through a corona field brings about chemical changes in the surface layers of mohair, making the fiber more tractable during processing.

During the 1970's, Western lab researchers experimented with several ways to make wool flame-resistant. Most successful was application to the fabric during dyeing of a chemical known as TBPA, short for tetrabromophthalic anhydride. The new treatment was economical, nonirritating, and long-lasting. Further, it impaired neither dyeing nor mothproofing. Tests of TBPA treatment by a major wool carpet manufacturer showed

that it far exceeded flame-spread standards for hospital use. An Oregon manufacturer reported that his firm had adopted the treatment to make wool blankets flame-resistant.

WRRC chemists were responsible for several innovations in dyeing wool. Perhaps the most significant saved time and energy by allowing wool to be permanently dyed in 1 minute or less. The process called for continuous dyeing in a hot (135°C to 150°C) ethylene glycol dye bath. Traditional dyeing required boiling wool in a water dye-bath for an hour or more. Also, under the right conditions, the hot ethylene glycol treatment can impart two-way stretch to woolen fabrics.

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In 1983, wool research was transferred from the WRRC to the Eastern center at Wyndmoor. ERRC scientists and U.S. wool growers were concerned because unacceptably high contamination of domestic wool with urine-stained and black-pigmented fibers led to frequent downgrading of the product. One reason for the poor showing is that U.S. growers raise sheep primarily for meat; in many other countries, sheep are bred and raised mainly for their wool. Dual processes are available to industry to bleach both types of discolored fibers, but the expense of conducting two different bleaching steps has made industry turn away from American-grown wool in favor of whiter imports. Now in a new ERRC-developed process, both stains and black fibers can be bleached in a single bath, saving time and energy for the textile maker. The chemical also costs less than bleaches used in the second step of the old dual process. The result is a very white wool, free of pigmented and stained fibers and competitive with foreign imports.